TECHNICAL MEMORANDUM

SUPPLEMENT TO RMC-1

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FURTHER INFORMATION ON NOTS COMPUTING REQUIREMENTS

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INTRODUCTION

This report summarizes the present outlook on the Station's immediate computing needs relative to jobs which can be done by IBM methods. Consideration is given to estimated requirements for equipment and operating personnel to handle the anticipated 67 man-months of work to come to the IBM Unit by 1 July 1950.

Technical Memorandum RMC-1, NOTS COMPUTING REQUIREMENTS, by Bruce Oldfield, dated February 1949, demonstrated that the Station has at this time and will have in the future a great number of problems requiring extensive computation. This Technical Memorandum further recommended that steps be taken to obtain a large-scale computing machine for the Station.

At the Research Board meeting of 18 July, consideration was given to the computing requirements and facilities at NOTS. It was recommended that the aforementioned Technical Memorandum be brought up to date with respect to two specific points:

A. What computational jobs are there on the Station which are actually formulated and ready for solution at this time or would definitely be so prepared by 1 July 1950 if computing equipment were available.

B. Of those computational jobs which may be included in (A), interest was primarily in those which can be done with equipment now on hand or which is currently available, viz. IBM equipment.

This supplement to Technical Memorandum RMC-1 is divided into three sections:

A. Current facilities and work load in the Computing Section, IBM Unit.

B. Requests for computational work which are expected by 1 July 1950.

C. Estimates and Recommendations relative to the completion of current computational jobs.

A. Current Facilities and Work Load in the Computing Section, IBM Unit

At this time the IBM Unit is equipped with the following machines:

a. One type 016 Key Punch which is a hand operated machine used to punch data into cards as read from original documents.

b. One type 075 Sorter which sorts into groups and/or counts cards according to punched holes.

c. One type 077 Collator which compares one card with another for the purposes of checking numerical sequences of files of cards, matching one file with another or merging two sequenced files into one.

d. Two type 519 End Printing Punches which read information on one card and transfer this information to another card, translate certain pencil marks on cards into punched holes and punch information obtained from the counters of the Tabulator, to which it may be connected by a cable.

e. One type 405 Tabulator which adds, subtracts or prints information as read from cards.

f. Two type 602 Multipliers which by electro-mechanical means, multiply, divide and accumulate quantities punched into cards.

g. One type 604 Multiplier which by electronic means, multiplies, divides and accumulates quantities punched into cards.

The above equipment is currently being operated by a staff of seven as follows:

a. Four members of the Mathematics Division, Computing Section.

b. Three members of the Measurements Division, Assessment Section, who spend full time in the IBM Unit.

Approximately 1/3 to 1/2 of the available machine time is used by the members of the Assessment Section in work related to routine reduction of data. The remaining 1/2 to 2/3 of the available time is used by the members of the Computing Section in work related to specific problems submitted to the IBM Unit by other groups on the Station.

The work done in the IBM Unit, for the most part, is dependent upon the multiplying machines since operations requiring multiplication and division are more frequent in technical computation than operations requiring extensive sorting, printing or summing. Hence, the machines listed in (a) to (e) above may be regarded as tools contributing to the multipliers, the latter ordinarily being the bottleneck if and when such a condition exists.

The IBM Unit is currently operating near its maximum work load for a 40-hour week. This maximum is imposed by two factors, first a personnel shortage; second, and most important, the aforementioned shortage of multiplier time.

B. Requests for Computational Work Which are Expected by 1 July 1950

The following tabulation is the result of an informal survey intended to supplement Technical Memorandum RMC-1. Items considered were Station computing requirements at the present time or expected requirements in the immediate future, which can be handled by IBM equipment. While this informal survey followed the general pattern of that which resulted in the original Technical Memorandum RMC-1, there are no doubt several problems not included simply because every individual on the Station who might have a computational job was not contacted. Furthermore, the problems listed below were not investigated in great detail, hence the time estimates may be in error. Also, the order of listing does not indicate any suggested priority. In fact, certain problems could be left undone in favor of others on the list or new ones that might be forthcoming.

TABULATION OF EXPECTED COMPUTATIONAL JOBS

Item	Requesting Group	Type of Problem	Date Expected*	Time Required**
1.	Statistics Section	(a) Obtain certain statistical distributions by experiment based on random samples	October 1949	3
2.	Exterior Ballistics Section	(a) Numerical solutions of differential equations	October 1949	6
		(b) Reevaluation and extension of certain tables of ballistic functions	October 1949	6

* Date when work might be expected if time and equipment were available.
** Estimated minimum number of man-months required to 1 July 1950 with present equipment.

TABULATION OF EXPECTED COMPUTATIONAL JOBS (Continued)

Item	Requesting Group	Type of Problem	Date Expected*	Time Required**
2.	Exterior Ballistics Section	(c) Prepare punch card tables for use in curve fitting	October 1949	1
3.	Assessment Section	(a) Reduction of Bowen camera data	Now in progress	9
		(b) Theodolite data reduction	Now in progress	9
		(c) Computation of drag coefficients	No definite time	1
		(d) Statistical studies relative to reduction of range data	No definite time	3
4.	Physical Chemistry Section	(a) Crystal structure calculations	December 1949	3
5.	Analysis and Reports Section	(a) Computations relative to development of sighting equipment	Now in progress	1
		(b) Computations relative to development of sighting equipment	Within six months	4
6.	Aerodynamics Section	(a) Computation of flutter derivatives	Now in progress	3
7.	Explosives Department	(a) Non-linear simultaneous partial differential equations	October 1949	5
		(b) Non-linear simultaneous algebraic equations	October 1949	3
		(c) Special statistical problems	October 1949	3

* Date when work might be expected if time and equipment were available.

** Estimated minimum number of man-months required to 1 July 1950 with present equipment.

TABULATION OF EXPECTED COMPUTATIONAL JOBS (Continued)

Item	Requesting Group	Type of Problem	Date Expected*	Time Required**
8.	Theory and Evaluation Section	(a) Water entry of Flat Plate	Now in progress	6
9.	Aerophysics Section	(a) Computations relative to transmission of certain radiations through the earth's atmosphere	September 1949	1

* Date when work might be expected if time and equipment were available.
** Estimated minimum number of man-months required to 1 July 1950 with present equipment.

The above tabulation includes a total 67 man-months of computation, 18 of which are devoted to the routine reduction of Assessment Section data. In addition to the work tabulated above there were several other jobs which were in need of computation. For these however, estimates of a definite time schedule were not possible. Time schedules for some of these depend upon certain theoretical work now in progress and were mentioned in Technical Memorandum RMC-1; and for others, upon how certain new IBM equipment, currently on order and expected to arrive by 1 January 1950, may be used. This new equipment is described below in Section C of this Supplement.

C. Estimates and Recommendations Relative to the Completion of Current Computational Jobs

In Section B, above, two factors were mentioned which have imposed a condition on the IBM Unit such that little or no additional work may be undertaken. These two factors were a shortage of personnel and a shortage of multiplier time. These two are closely related for with the present amount of equipment perhaps one but certainly not more than two additional personnel could be used since the present shortage of multiplier time would only be made more acute. The answer to the problem then would seem to be either to obtain more people and more multipliers or to obtain more people and employ them on a second shift. Both of these possibilities have been considered and the only definite action to date has been to order additional equipment, described below.

a. The two type 602 Multipliers noted in Section A, item (f) are to be replaced by two type 602-A Multipliers. The 602-A's are expected to be better than the 602's from the point of view of greater speed and flexibility in certain operations and general reliability, the latter being expected to reduce the amount of repair time required. These machines should be delivered by 1 February 1950.

b. A Card Programmed Electronic Calulator of the type mentioned in (c) below has been ordered. This equipment should be delivered by 1 January 1950.

c. The type 405 Tabulator and the type 604 Multiplier, items (e) and (g) noted in Section A, are to be replaced by a new machine called the

Card Programmed Electronic Calculator. This device consists of three components:

1. A type 604 Multiplier of greater capacity and flexibility than the one now in operation.
2. A type 417 Tabulator which has greater speed and flexibility than the type 405 now in operation.
3. A storage unit.

These three components are so constructed that the Multiplier and Tabulator may be used separately, as they are now being used, or together in conjunction with the Storage Unit. In the latter arrangement the three components become one machine, the main advantage of which being that it will be possible to sequence operations of considerable length. This will open up new possibilities for computation, not only in speeding up the present routine reduction work but also in making it possible to solve certain problems, for example, those requiring long iterations, which are not suitable to the machines when used as individual units. These replacements should be delivered by 1 February 1950.

By the time the equipment noted in (a), (b) and (c) above is in operation it is hoped that the present shortage of multiplier time will no longer exist. It is possible however, that the Card Programmed Calculators will open up other fields of computation to such an extent that a new maximum will be reached.

On the basis of problems listed in Section B above, however, it appears that the equipment now in use, plus that on order, will be adequate to take care of the Division's immediate needs relative to problems of the type which can be undertaken by IBM methods.

The problem of personnel, while not acute at present due to the current shortage of multiplier time, will be much more serious when the new equipment is delivered. It is estimated that three or four additional personnel will be required to keep the two Card Programmed Calculators and the two 602-A Multipliers in efficient operation on a 40 hour per week basis. One of these should be a CAF-4 or 5 for assisting with long and routine runs on the Card Programmed Calculators, the others should be P-2's or 3's who would set up problems originally. Steps should be taken to obtain these additional personnel in the near future since one or two months of training before the arrival of the Calculators would be important in getting the machines into immediate use. The present operating force of seven, four from the Mathematics Division and three from the Assessment Section, will supply a total of 63 man-months by 1 July 1950. However, the Unit Supervisor, one of the four members of the Mathematics Division, has been unable to accept any extensive problems himself, because of the details of instruction assistance and consultation with members of the Unit and other Sections. A second member of the four Mathematics Division personnel is a CAF operator, and is limited as to the type of problems which can be handled. In addition to working on certain problems independently, this operator assists other members of the Unit as required in particular problems. The four personnel mentioned above, therefore will not be able to provide more than approximately 2½ man-months of time per month for actual computational work on the machines